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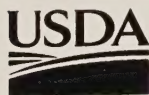
# Forest Health Protection

TECHNOLOGY  
TRANSFER

*Bibliography*

## National Center of Forest Health Management — *Bibliography*

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For additional copies of this publication or publications listed in the Bibliography, contact Richard Reardon in Morgantown, WV at (304)285-1566.



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# National Center of Forest Health Management — *Bibliography*

## Introduction

This paper is the third in a series that follows the technology developed by the USDA Forest Service for integrated pest management (IPM) of the gypsy moth. The first paper covered the Maryland Integrated Pest Management Gypsy Moth Project (Reardon *et al.* 1993), and the second covered the Appalachian Integrated Pest Management Gypsy Moth Project (Reardon 1991, 1996).

The National Center of Forest Health Management, created by the USDA Forest Service in Morgantown, West Virginia, in 1993, took up methods improvement and other studies for the gypsy moth where the Appalachian IPM Project left off. As these projects were completed, the work of the Center focused on environmentally acceptable use of bioinsecticides and biocontrols for managing pest species, and the impacts of pest management methods on forest ecosystems.

This paper focuses on integrated pest management technology developed during 1993-1995 at the National Center of Forest Health Management. It includes a bibliography of publications that reflect the work of the Center during this time. A subject index is provided.

## Background

The USDA Forest Service began a pilot study of the feasibility of using an IPM approach to manage low-level gypsy moth populations in three counties in Maryland in 1983. This 5-year project was successful in reducing low-level gypsy moth populations, but additional environmentally compatible technologies and biopesticides were needed, as well as demonstration of the IPM concept over a mountainous area (Reardon *et al.* 1993).

In late July 1987 the Forest Service created the Appalachian Integrated Pest Management Gypsy Moth Project (AIPM Project). This 5-year project encompassed 20 counties in West Virginia and 18 counties in Virginia (Reardon 1991). The AIPM Project provided (1) technology for managing low-density gypsy moth infestations; (2) numerous publications documenting the technology and methods developed; (3) technologies and methods used during operational suppression and eradication programs, as well as the Slow-the-Spread Pilot Project; and (4) a transition to technology development with national scope through the National Center of Forest Health Management (Reardon 1996).



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# National Center of Forest Health Management

## *Program of Work*

The USDA Forest Service created the National Center of Forest Health Management in 1993, in Morgantown, West Virginia. The Center was assigned to the Northeastern Area State and Private Forestry, a unit of the Forest Service headquartered in Radnor, Pennsylvania, with a program of work addressing issues of national importance approved by the Forest Service's Washington Office. A Board of Directors composed of university, State agency, other Federal agency, and private representatives provided overall review and recommendations of the program of work.

During its initial year, the Center completed gypsy moth IPM methods improvement, pilot studies, and data analyses begun by the AIPM Project. In 1994, the focus of study expanded to include pests affecting the health of the nation's forests including the gypsy moth. Highest priority was placed on difficult problems of national importance that others had not or had only partially addressed.

## *Concept*

The concept for the National Center grew from the recognition that the development of technologies to protect forest health needed to be accelerated and that they had to be environmentally acceptable and compatible with ecosystem management, stewardship and urban forestry goals. A national group — the Forest Service's Methods Application Group in Fort Collins, Colorado — already existed for developing aerial survey technology, pest model development and impact assessment. Therefore, the National Center, in close cooperation with Forest Service Research units and the Methods Application Group, took a leading role in stimulating the development and use of environmentally acceptable methods in IPM programs through work on biopesticides, biological controls, and determining the impacts of pest management on forest ecosystems.

## *Culmination*

The Center was in existence for about 2 years when, in May 1995, it joined with the Methods Application Group to form the Forest Health Technology Enterprise Team, with offices in Morgantown, West Virginia, and Fort Collins, Colorado. The Forest Service's Pesticide Management Group located in Davis, California, became part of the team. The Board of Directors was maintained as a Steering Committee and the scope of work expanded to include development of application technology with interaction with the Methods Equipment Development Center in Fort Missoula, Montana.



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## References

Reardon, R. 1991. Appalachian gypsy moth integrated pest management project. *Forest Ecology and Management* 39:107-112.

Reardon, R. 1996. Appalachian Integrated Pest Management Gypsy Moth Project: Summary and Bibliography. NA-TP-05-96. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 42 p.

Reardon, R.; Venables, L.; Roberts, A. 1993. The Maryland Integrated Pest Management Gypsy Moth Project 1983-1987. NA-TP-07-93. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 35 p.

---

# Bibliography

## *Technology and Methods Development*

### Intervention Methods

#### Mating Disruption

Leonhardt, B.; Leonard, D.; Mastro, V.; McLane, W.; Reardon, R. 1995. **Use of controlled-release formulations of pheromone for disruption of gypsy moth mating.** In: Proceedings International Symposium Controlled Release of Bioactive Materials 22:53-54.

Mastro, V.; Leonhardt, B.; Reardon, R.; Leonard, D.; McLane, W. 1994. **Gypsy moth mating disruption.** In: Proceedings of the 1994 Annual Gypsy Moth Review; 1994 October 30 - November 2; Portland, OR; 188.

Reardon, R.; Leonard, D.; Mastro, V.; Leonhardt, B.; McLane, W.; Talley, S. 1995. **Using mating disruption to manage gypsy moth: a review.** FHM-NC-08-95. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 77 p.

Thorpe, K.; Leonhardt, B.; Mastro, V.; Leonard, D.; McLane, W.; Reardon, R.; Talley, S. 1997. **Cooperative efficacy of two controlled-release gypsy moth mating disruption formulations.** J. Chemical Ecology (In press).

#### Diflubenzuron (Dimilin®)

Onken, A.; Reardon, R.; Barry, J. 1994. **Diflubenzuron database.** FHM-NC-02-94. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 375 p.

Onken, A.; Reardon, R.; Barry, J. 1994. **Diflubenzuron database — Update No. 1.** FHM-NC-02-94. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 21 p.

#### *Bacillus thuringiensis*

Falchieri, D.; Mierzejewski, K.; Maczuga, S. 1995. **Effects of droplet density and concentration on the efficacy of *Bacillus thuringiensis* and carbaryl against gypsy moth larvae.** Journal of Environmental Science and Health B30:535-548.

Maczuga, S.; Mierzejewski, K. 1995. **Droplet size and density effects of *Bacillus thuringiensis kurstaki* on gypsy moth larvae.** Journal of Economic Entomology 88:1376-1379.



---

Reardon, R.; Dubois, N.; McLane, W. 1994. ***Bacillus thuringiensis* for managing gypsy moth: a review.** FHM-NC-01-94. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 32 p.

***Entomophaga maimaiga***

Hajek, A. 1997. **Fungal and viral epizootics in gypsy moth populations in central New York.** Biological Control 10:58-68.

**Nucleopolyhedrosis Viruses**

Cunningham, J.; Payne, N.; Simard, E.; Brown, K. 1996. **Sticker adjuvant effectiveness with gypsy moth virus Carrier 038.** Sault Ste. Marie, Ontario: Canadian Forest Service, Great Lakes Forestry Centre; 13 p.

Onken, A.; Reardon, R. 1994. **Douglas fir tussock moth nucleopolyhedrosis virus TM-Biocontrol-1 — bibliography.** FHM-NC-06-94. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 42 p.

Onken, A.; Reardon, R. 1994. **Gypsy moth nucleopolyhedrosis virus Gypchek — bibliography.** FHM-NC-05-94. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 100 p.

Podgwaite, J.; Reardon, R. 1994. **Gypchek: Where we've been...Where we're going.** In: Proceedings of the 1994 Annual Gypsy Moth Review; 1994 October 30-November 2; Portland, OR; 168-169.

Podgwaite, J.; Reardon, R. 1995. **Production and formulation of Gypchek.** In: USDA Interagency Gypsy Moth Research Forum 1995. General Technical Report NE-213. Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station; 106.

Podgwaite, J.; Reardon, R.; Webb, R. 1994. **Evaluations of Gypchek formulations in Michigan in 1993.** In: Proceedings of the 1994 Annual Gypsy Moth Review; 1994 October 30-November 2; Portland, OR; 97-101.

**Nontarget Organisms**

Butler, L.; Kondo, V.; Blue, D. 1997. **Effects of Tebufenozide (RH-5992) for gypsy moth suppression on nontarget canopy arthropods.** Environmental Entomology (In press).

Miller, J. 1995. **Caterpillars of Pacific Northwest forests and woodlands.** FHM-NC-06-95. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 80 p.



- 
- Miller, J.; Reardon, R. 1997. **Protocols for assessing effects of *Bacillus thuringiensis* var. *kurstaki* on nontarget Lepidoptera.** FHTET-97-13. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 28 p.
- Onken, A.; Reardon, R. 1995. **The effects of diflubenzuron on nontargets — bibliography.** FHM-NC-02-95. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 69 p.
- Onken, A.; Reardon, R. 1995. **The effects of diflubenzuron on nontargets — bibliography (Update No. 1).** FHM-NC-02-95. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 125 p.
- Onken, A.; Munson, S.; Reardon, R. 1995. **The effects of *Bacillus thuringiensis* var. *kurstaki* on nontargets — bibliography.** FHM-NC-03-95. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 28 p.
- Reardon, R. 1994. **Impacts of treatment and gypsy moth defoliation on nontarget Lepidoptera.** In: Proceedings of the 1994 Annual Gypsy Moth Review; 1994 October 30-November 2; Portland, OR; 209-210.
- Reardon, R.; Wagner, D. 1995. **Impact of *Bacillus thuringiensis* on nontarget lepidopteran species in broad-leaved forests.** In: Biorational Pest Control Agents — Formulation and Delivery [Hall, F. and Barry, J. ed.] 207th National Meeting of the American Chemical Society, San Diego, CA. 1994 March 13-17; American Chemical Society 595:284-292.
- Stout, B. 1996. **Potential effects of Mimic on selected aquatic macroinvertebrates.** Final report. Wheeling, WV: Wheeling Jesuit University; 17 p.
- Sullivan, J.; Hall, S.; Schweitzer, D. 1997. **Comparison of the effects of *Bacillus thuringiensis* and Gypchek on the macro-moth faunas of three types of habitat in the southeast coastal plain of North Carolina.** Final report. Raleigh, NC: North Carolina Natural Heritage Program; 30 p.
- Wagner, D.; Henry, J.; Peacock, J.; McManus, M.; Reardon, R. 1995. **Common caterpillars of eastern deciduous forests.** FHM-NC-04-95. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 31 p.
-

---

## Aerial Application Technology

Bryant, J.; Mierzejewski, K. 1997. **Swath kit for windows - user's manual**. Version 1.0. State College, PA: Droplet Technologies, Inc.; 32 p.

Maczuga, S.; Mierzejewski, K. 1994. **Canopy deposition characteristics of three formulations of NPV aerially applied to a mixed hardwood forest in Michigan in 1993**. In: USDA Interagency Gypsy Moth Research Forum 1994. General Technical Report NE-188, Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station; 42 p.

Maczuga, S.; Mierzejewski, K. 1994. **Effects of simulated field deposits of Foray 48B on gypsy moth larvae**. Report AATL 94-2. University Park, PA: The Pennsylvania State University Department of Entomology, Aerial Application Technology Laboratory; 11 p.

Maczuga, S.; Mierzejewski, K. 1995. **Differences in foliar deposition of Gypchek and gypsy moth larval mortality caused by leaf area index at time of spray**. Report AATL 95-1. University Park, PA: The Pennsylvania State University Department of Entomology, Aerial Application Technology Laboratory Report; 11 p.

Mierzejewski, K. 1995. **Use of the FSCBG program to simulate off-target drift of aerially applied malathion in cotton crops**. Report AATL-95-1. University Park, PA: The Pennsylvania State University Department of Entomology, Aerial Application Technology Laboratory; 21 p.

Mierzejewski, K.; Buzzard, W.; Laudermilch, G. 1994. **Operational use of differentially corrected GPS based aircraft tracking guidance and flight path recording systems in forest spray projects**. Report AATL 94-1. University Park, PA: The Pennsylvania State University Department of Entomology, Aerial Application Technology Laboratory; 15 p.

Mierzejewski, K.; Buzzard, W.; Laudermilch, G. 1995. **An evaluation of the Satloc Foreststar in the 1995 Pennsylvania forest insect pest suppression program**. Report AATL 95-2. University Park, PA: The Pennsylvania State University Department of Entomology, Aerial Application Technology Laboratory; 40 p.

Miller, D.; Reardon, R.; McManus, M. 1995. **An atmospheric primer for aerial spraying of forests**. FHM-NC-07-95. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 19 p.

---

## ***Technology Transfer***

Bullard, A. 1995. **National Center of Forest Health Management — An Update.** In: Proceedings of the 1995 Annual Gypsy Moth Review; 1995 November 5-8; Traverse City, MI; 37-39.

Frey, T. 1993-1995. **National Center of Forest Health Management News.** Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry. Issues 1(1) to 3(2).

Frey, T. 1994. **Bibliographies maintained by Forest Health Protection.** Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 1 p.

Frey, T. 1995. **National Center of Forest Health Management.** Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 1 p.

Kurz, W.; Greig, L.; Bernard, D. 1994. **The National Center of Forest Health Management Planning Workshop Report.** Vancouver, British Columbia: ESSA Technologies Ltd.; 64 p.

McCullough, D.; Sadof, C. 1997. **Pine shoot beetle compliance program for Christmas trees — a manual for Christmas tree growers.** East Lansing, MI: Michigan State University Extension Bulletin E-2615. 15 p.

Onken, A.; Reardon, R. 1994. **Insects and diseases that affect hemlock (*Tsuga* spp.) —bibliography.** FHM-NC-04-94. Morgantown, WV: USDA Forest Service, Northeastern Area State and Private Forestry; 139 p.

Reardon, R. 1994. **National Center of Forest Health Management.** In: Proceedings of the 1994 Annual Gypsy Moth Review; 1994 October 30-November 2; Portland, OR; 164-165.

U.S. Department of Agriculture, Forest Service. 1993. **National Center of Forest Health Management Strategic Plan.** Morgantown, WV; 17 p.

U.S. Department of Agriculture, Forest Service. 1993. **National Center of Forest Health Management Fiscal Year 1993 Plan of Work.** Morgantown, WV; 30 p.

U.S. Department of Agriculture, Forest Service. 1994. **National Center of Forest Health Management Fiscal Year 1994 Plan of Work.** Morgantown, WV; 44 p.

U.S. Department of Agriculture, Forest Service. 1994. **National Center of Forest Health Management Fiscal Year 1993-94 Status Report.** Morgantown, WV; 33 p.

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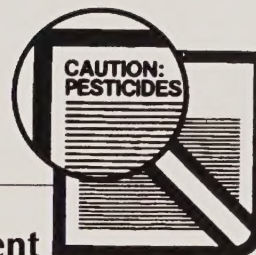
---

U.S. Department of Agriculture, Forest Service. 1995. **National Center of Forest Health Management Fiscal Year 1995 Plan of Work.** Morgantown, WV; 29 p.

U.S. Department of Agriculture, Forest Service. 1995. **National Center of Forest Health Management Fiscal Year 1994 Status Report.** Morgantown, WV; 32 p.

U.S. Department of Agriculture, Forest Service. 1995. **National Center of Forest Health Management Fiscal Year 1995 Accomplishment Report.** Morgantown, WV; 32 p.





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